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EVALUATION OF NON-CONING TRAFFIC PAINT 1983/84

MATERIALS INFORMATION
ENGINEERING MATERIALS OFFICE

EVALUATION
OF
NON-CONING TRAFFIC PAINT
1983/84

by

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CHEMICALS SECTION

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SUMMARY

The accelerated abrasion testing of traffic paint samples under high density traffic conditions performed in the fall of 1982 was unsatisfactory because of the difficulty in determining relative durabilities of the paint samples within the short test period of four months. Another evaluation was therefore carried out in 1983-84 which included field service testing for one full year at the usual test sites located on Highway 401 near Port Hope and a second site east of Belleville. The "merry-go-round" method of accelerated performance testing of traffic paint was also repeated.

Based on laboratory physical and chemical analyses and relative durabilities determined by field service testing, the white and yellow traffic paint samples from three paint manufacturers were found to conform to the laboratory test requirements of specification MTC Form 1710, February 1983 for non-coning traffic paint. However, the test data obtained from the 1984 trial batch applications in Huntsville district indicated that under the conditions of the test (at low application temperatures) all three of the yellow traffic paint samples tested failed to meet the no tracking time requirement. Therefore, additional limited field testing in 1985 using a zone striping machine capable of heating the paints to the specified high temperatures, appeared to be necessary prior to final acceptance or rejection of the paint samples undergoing trial application tests.

A second attempt at determining comparative durabilities of traffic paint by means of the "merry-go-round" test rig was discontinued because of premature pavement and equipment failures and it was concluded that this method of accelerated performance testing of traffic paint samples was impractical.

INTRODUCTION

In 1982, an accelerated qualification test program for evaluating traffic paint was carried out by the Chemicals Section. But the shortened test period was found to be unsuitable for the selection of satisfactory traffic paints as described in the Engineering Materials Office Materials Information Report No. 52.

The applicable specification used in the 1982 test program was MTC Form 1710, February 1982 Material Specification for Coning and Non-Coning Traffic Paint. Due to excessive variation in the properties of the products from different manufacturers, the specification was revised again in 1983 to include additional restrictions on coarse particle size, volatile matter content, and trichloroethylene content. In addition, because of the unsuitability of the accelerated test procedure used in 1982, the current field service testing for one full year including severe winter service conditions was performed at the usual test sites located on Highway 401 near Wesleyville interchange and a second site located east of Belleville.

The "merry-go-round" method of accelerated performance testing of traffic paint as described in Materials Information Report No. 52 was performed again in the summer of 1983 to determine if it could be used as an alternative method for accelerated field service testing of traffic paint.

Applicable Specifications (Appendices 1 and 2)

(a) MTC Form 1710, February 1983 Material Specification for Coning and Non-Coning Traffic Paint.

(b) MTC Form 1750, February 1982 Material Specification for Traffic Paint Reflectorizing Glass Beads.

TEST SAMPLES

Invitations to submit traffic paint test samples were sent by the Purchasing Office to about fifty paint suppliers. Nine samples each of white and yellow traffic paint were received from six suppliers for the 1983/84 evaluation (Appendix 3).

For reference purpose, batch samples from the 1982 shipments of Ibis Niteline II and Niagara #95474 non-coning traffic paint were used to determine comparative durabilities of the test stripes in the field service test.

TEST SITES

Transverse test stripes of the non-coning white traffic paint samples were applied at the following locations for field service test:

Site 1 Highway 401, eastbound, about 1 km west of Wesleyville interchange (near Port Hope)

Site 2 Highway 401, eastbound, about 3 km east of Highway 62 (Belleville)

In addition, test stripes were applied in a similar manner as that described in Materials Information Report No. 52 at the "merry-go-round" test site located next to the parking lot north of the Central Building, MTC Downsview.

TEST PROCEDURE FOR SERVICE TEST

The paint samples were tested in the laboratory for physical and chemical requirements prior to field service testing. Although all of the test samples were analyzed in the laboratory, only the white paints were field service tested because the matching yellow paint had similar composition, except for pigmentation, as that of the corresponding white paint.

Nine test samples of white traffic paint and two reference paints (Ibis Niteline II and Niagara 95474) were applied at the Highway 401 test sites on June 6, 14, and 15, 1983. Although many of the paint samples failed to meet laboratory test requirements (Tables 1 to 4), all nine test samples of white traffic paint, together with the two reference paints, were field service tested to obtain comparative performance test data.

Paint application temperature was maintained at 60°C at a pressure of 5512 kPa (800 p.s.i.). During application of the transverse test stripes 3 metres in length, paint properties such as sprayability, spatter, and overspray were noted. Approximately the same dry film thickness (225 µm) of each paint sample stripe was applied. Reflectorizing glass beads were applied at the rate of 0.7 kg/L at 165 kPa (24 p.s.i.) pressure. Swarolite glass beads from 1983 shipments were used in the traffic paint evaluation.

The test stripes were measured for reflectance at the time of application and at 3, 6, 9, and 12 months after application. Photographs of the test stripes in the wheel track area adjacent to the shoulder were taken for wear determination after 6, 8, 10, and 12 months of service testing of the paint stripes. The general appearance of the test stripes at the conclusion of the 12-month test period was rated as follows:

10 - perfect
9,8,7 - good or slight failure
6,5,4 - fair or intermediate failure
3,2,1 - poor or bad failure
0 - complete failure

The traffic paint samples were also applied at the "merry-go-round" test site over bituminous pavement surface which was installed and utilized in a similar test in 1982. The test stripes were applied at an angle of about 45° from the tangent to the circular wheel tracks of the test rig. The test was started on August 15, 1983 in order to include both summer and winter conditions during the test period.

TEST RESULTS

Laboratory Physical and Chemical Tests (Tables 1 to 4)

The white and yellow traffic paint samples have been tested in the laboratory prior to field service testing in order to determine whether the samples conform to the requirements of Table 1 of the specification. Only three white and three corresponding yellow paint samples from three manufacturers appear to meet requirements. All others fail in one or more of the specified material requirements as shown in Tables 1 to 4. Analyses of the volatile component of the paint samples indicate that four out of nine white paints (and corresponding yellow paint samples) contain some chlorinated solvent. The rest of the paint samples contain varying concentrations of aromatic, aliphatic and/or ketone or alcohol solvents.

Additional restrictions on coarse particle size and volatile matter content included in the specification have minimized the amount of coarse particles in the paint samples which should reduce or eliminate excessive wearing of spray equipment parts during paint application. The limitation on maximum solvent content by volume has effectively reduced the wide variation in total solids content of traffic paint formulations from different manufacturers. Traffic paint has become more uniform in composition with differences mainly in the solvent component.

Field Service Tests (Table 5)

The paint stripes applied transversely on the highway for field service testing were evaluated at specific intervals during the twelve-month test periods for visibility (reflectance) and durability (abrasion resistance) as well as for general appearance and colour after one year of service. An attempt was made to estimate the degree of paint overspray on the pavement at the time of application of the transverse test stripes but it was not possible because the test area became totally covered with fine paint overspray. The determination of the no tracking time was also not possible under the conditions of the test application. Loading, spraying, and drying properties of traffic paints are best determined by actual application of the selected paints using the regular zone striping machine as stated in the specification (Sec. 1710.09.01.02).

The field service test results show that most paint samples formulated to meet the current traffic paint specification have good durability equal to or better than that of Ibis Niteline II reference paint and considerably better than that of the previously approved Niagara #95474 (white) non-coning traffic. Those paint samples meeting all of the specification material requirements and laboratory service test requirements have been recommended for further evaluation of paint application properties using the Ministry zone marking equipment in a selected district (Table 6). The purpose of the trial batch application is to determine such characteristics as ease of pumping during loading and spraying, no tracking time, paint overspray and dribbling on pavement and equipment, paint temperature and pressure and any equipment adjustments which may be necessary to obtain satisfactory spray pattern.

Trial Batch Application - Huntsville District

Three yellow traffic paint samples meeting laboratory test requirements were selected for additional application tests using the Ministry painting equipment as arranged by Special Maintenance Services (related correspondence can be found in Appendices 4 and 5). No further field testing of the matching white traffic paints was done because their properties were considered to be similar to those of the corresponding yellow paints. Two drums (approximately 400 L) of each of the following yellow traffic paints were purchased for trial application on Highway 60 in Huntsville district on September 11 and 12, 1984:

Monarch Paint Co.	#103856
Niagara Paint & Chemical Co. Ltd.	#103858
Ibis Products Ltd.	#40-3235

Test data on the trial application in Huntsville district reported by Special Maintenance Services (Appendix 6) indicate the following:

(1) All three of the yellow test paints have satisfactory pumping properties during loading and spraying.

(2) The no tracking times of the three test paints are excessively long under the test conditions and exceed specification requirement.

(3) Light wet overspray and dribbling of the paints have been noted under the conditions of the test.

The maximum paint temperature attainable on the Huntsville zone marking equipment is reported as 66°C which is well below the 70-80°C range specified in MTC Form 1710. As a result, the spraying and drying properties of the test paints at the required paint temperature are still unknown. Further trial application tests appear to be necessary to determine the effect of increased paint temperature on the no tracking time as well as on overspray and dribbling characteristics of the applied paints. If increasing paint application temperature has little effect on the long drying time of the current test paints, further modification of Form 1710 specification may be necessary. An increase in pigment/binder ratio may be required to improve the drying characteristics of the non-coning traffic paint at the risk of increasing paint overspray and decreasing durability.

"Merry-go-round" Test

The "merry-go-round" method of accelerated performance testing of traffic paint was previously carried out in the fall of 1982 but the results were inconclusive because of the difficulty in separating the more durable paints from those with lesser durability within the two week test period. The test procedure as described in Materials Information Report 52 was repeated in 1983 with the intention of increasing the test duration to include both summer and winter climatic conditions. The test commenced on August 15, 1983. After approximately three weeks of operation with periodic equipment repairs, the test was terminated due to deep rutting (8 to 10 mm) of the pavement surface in the circular wheel track caused by softening of the pavement in the summer heat. The paint stripes cracked in the deep grooves and uneven wearing occurred due to the bouncing of the wheels. In addition, one side of each tire was completely worn due to the scuffing action of the wheels in the circular track. No test data for the determination of comparative durabilities of traffic paints were obtainable by this method of accelerated performance testing.

CONCLUSIONS AND RECOMMENDATIONS

Based on laboratory physical and chemical test results and relative durabilities determined by field service testing, the following white and yellow traffic paint samples have been found to conform to the laboratory test requirements of specification MTC Form 1710, February 1983 for non-coning traffic paint and they have been recommended for trial batch application:

Manufacturer	White Paint	Yellow Paint
Monarch Paint Co.	103855	103856
Niagara Paint & Chemical Co.	103857	103858
Ibis Products Ltd.	40-3234	40-3235

Note

Monarch Paint Co. and Ibis Products Ltd. paints contain chlorinated solvent but the Niagara Paint and Chemical Co. products do not. If traffic paints with chlorinated solvent are used, spray equipment must not contain aluminum or zinc parts because of possible solvent breakdown and reaction with the metals to cause blockages in the spray equipment.

All other paint samples tested fail in one or more of the laboratory and field service test requirements and are not acceptable.

The trial batch applications in Huntsville district indicate that under the conditions of the test, all three of the yellow traffic paints recommended for trial application fail to meet the specified no tracking time requirement. Additional limited testing in 1985 using a zone marking machine capable of heating the paints to the required high temperature in the 70-80°C range has been suggested by Special Maintenance Services prior to final acceptance or rejection of the paint samples from the three suppliers. If the drying properties of the paints are not improved by increasing paint application temperature, then further modification of specification MTC Form 1710 may be necessary.

After two attempts and failures with the "merry-go-round" test rig to determine comparative durabilities of traffic paint, it is concluded that this method of accelerated performance testing of traffic paint is unsatisfactory and impractical as an alternative method of field service testing.

Table 1

Laboratory Physical Test Results of White Traffic Paints

Lab. No. 83-S-	Mfr.	Code No.	Mass kg/L	Viscosity K. U.		NPU mins.	Skin	Settle 12 mos.	Hiding m^2/L	Bleed	Coarse Part. (Approx. %)		Reflect. Y	Fineness Hegman
				@ 25°C	@ 7°C						60 mesh	100 mesh		
50004	Monarch	103855	1.58	86.5	107.6	8	nil	8.5	8.63	7	0.043	0.047	86.1	5.5
50006	Niagara	103857	1.51	83.9	110.1	13	nil	8.5	8.93	7	0.035	0.042	86.1	5.5
50008	Niagara	103877	1.52	84.0	101.2	7	nil	7.5 (soft)	8.93	7	0.018	0.031	85.7	2.5
50010	Mobil	656W1	1.59	80.0	103.6	9	nil	5 *	10.55	3 *	0.059	0.069	83.1 *	4.5
50011	Mobil	656W2	1.56	82.5	108.6	6	nil	5 *	9.81	3 *	0.002	0.003	82.0 *	4.5
50014	Ibis	40-3234	1.53	84.0	104.0	4.5	nil	7 (soft)	10.20	7	0.001	0.020	88.1	3.5
50016	Ibis	40-3460	1.41	85.0	121.8*	4	nil	8	10.99	7.5	0.002	0.004	88.3	2.0 (fastdry)
50018	Korzite	0-5566	1.35	78.0 *	112.2	5	nil	6 *	11.43	3 *	0.043	0.046	86.6	4.0
50020	Sherwin Williams	C97WG143	1.55	102.5 *	>143 *	7	nil	8.5	10.99	6.5	0.018	0.032	88.0	4.0
Form 1710 Feb. 1983	Spec. Requirements		-	80-90	120max.	-	nil	8 min.	8.37 min.	5 min.	nil	0.01% max.	84.0 min.	3 min.

* Indicates failure to meet specification requirements. NPU= No pick-up

Table 2

Laboratory Physical Test Results of Yellow Traffic Paints

Lab. No. 83-S-	Mfr.	Code No.	Mass kg/L	Viscosity K. U. @ 25°C	Viscosity K. U. @ 7°C	NPU mins.	Skin	Settle 12 mos.	Hiding m^2/L	Bleed	Coarse Part. (Approx. %) 60 mesh	Coarse Part. (Approx. %) 100 mesh	Reflect. Y	Fineness Hegman
50005	Monarch	103856	1.61	86.0	110.3	11	nil	8	8.63	8	0.005	0.019	63.7	5.5
50007	Niagara	103858	1.52	86.1	118.7	11	nil	8	8.39	6	0.003	0.007	64.6	5.5
50009	Niagara	103876	1.55	86.5	114.3	6	nil	6.5*	8.63	6	0	0.012	64.0	3.5
50012	Mobil	656Y1	1.55	85.5	105.9	9	nil	5 *	9.81	3 *	0.003	0.010	63.8	3.5
50013	Mobil	656Y2	1.59	88.0	104.9	5	nil	5 *	9.22	3 *	0.002	0.003	60.1	2.5
50015	Ibis	40-3235	1.54	86.5	104.8	4	nil	8	9.22	8	0.001	0.004	61.7	2.0
50017	Ibis	40-3461	1.42	84.5	136.4*	3.5	nil	8	8.93	8	0.002	0.005	64.6	2.0
50019	Korzite	0-5572	1.40	79.0*	130.2*	7	nil	6 *	10.99	4 *	0.024	0.027	62.3	3.5
50021	Sherwin Williams	C97YG65	1.55	104.5*	>143 *	10	nil	8	10.99	8.5	0.006	0.007	61.6	3.0
Form 1710 Feb. 1983	Spec. Requirements		-	80-90	120 max.	-	nil	8 min.	8.37 min.	5 min.	nil	0.01% max.	60 min.	3 min.

* Indicates failure to meet specification requirements. NPU= No pick-up

Table 3

Laboratory Chemical Test Results of White Traffic Paints

Lab. No. 83-S-	Mfr.	Code No.	Water %	Pigment %	Veh. Solids %	TiO_2 kg/L	Volatile % Vol.	Phthal Anhyd. %	Solvent Composition % by volume					
									Chlor.	Toluol	Xylol	VM + P	Alcohol	Ketone
50004	Monarch	103855	0.1	54.6	18.9	0.168	43.7	38.0	40	60	-	-	-	-
50006	Niagara	103857	0.4	54.6	19.7	0.164	42.3	40.3	-	99	-	-	-	-
50008	Niagara	103877	0.5	54.7	20.6	0.164	43.6	43.1	-	87	-	-	13	-
50010	Mobil	656W1	0.1	53.4	20.2	0.151	42.6	38.1	28	50	-	Nitro propane 8	13	1
50011	Mobil	656W2	0.1	55.9 *	20.8	0.149	42.6	43.6	-	78	9	Nitro propane 5	8	-
50014	Ibis	40-3234	0.3	53.7	20.4	0.147	43.4	41.4	15	40	-	37	-	8
50016	Ibis	40-3460	0.3	51.9	20.2	0.138*	48.7 *	40.9	4	32	-	62	-	2
50018	Korzite	0-5566	0.2	47.7	18.3	0.153	58.2 *	45.2	-	50	8	42	-	-
50020	Sherwin Williams	C97WG143	0.2	54.9	21.5	0.168	43.5	42.4	-	85	3	12	-	-
Form 1710 Feb. 1983	Spec. Requirements		0.5 max. by mass	54.0 max. by mass	18.0 min. by mass	0.15 min.	46.0 max. by volume	40.0 min. by mass						

* Indicates failure to meet specification requirements

Table 4

Laboratory Chemical Test Results of Yellow Traffic Paints

Lab. No. 83-S-	Mfr.	Code No.	Water %	Pigment %	Veh. Solids %	TiO_2 + $PbCrO_4$ kg/L	Volatile % Vol.	Phthal Anhyd. %	Solvent Composition					
									Chlor.	Toluol	Xylol	VM + P	Alcohol	Ketone
50005	Monarch	103856	0.3	53.7	18.7	0.156	42.9	38.3	45	55	-	-	-	-
50007	Niagara	103858	0.2	54.7	19.8	0.155	45.5	40.1	-	99	-	-	-	-
50009	Niagara	103876	0.4	54.8	20.7	0.159	42.9	43.4	-	96	<1	-	3	-
50012	Mobil	656Y1	0.3	56.5*	20.5	0.133*	43.8	39.4	-	62	25	Nitro propane 5	7	1
50013	Mobil	656Y2	0.3	55.7*	20.0	0.147	42.5	44.9	10	70	5	Nitro propane 3.5	10	1.5
50015	Ibis	40-3235	0.3	53.4	20.2	0.144	43.6	40.5	15	40	-	35	-	10
50017	Ibis	40-3461	0.4	52.2	20.0	0.142	44.1	41.6	2	33	-	63	-	2
50019	Korzite	0-5572	0.2	49.4	18.1	0.161	55.7 *	44.1	-	60	10	30	-	-
50021	Sherwin Williams	C97YG65	0.2	55.1*	21.6	0.164	43.1	41.9	-	78	4	17	-	<0.5
Form 1710 Feb. 1983	Spec. Requirements		0.5 max. by mass	54.0 max. by mass	18.0 min. by mass	0.15 min.	46.0 max. by volume	40.0 min. by mass						

* Indicates failure to meet specification requirements

Table 5

1983-84 Field Service Test Results of White Traffic Paint Bid Samples

Lab. No. 83-S-	Mfr.	Code No.	(site 1) % Paint Remaining after 1 yr. service	(site 1) Appearance + Colour after 1 yr. service	Reflectance Rating	Durability Rating	Service Factor	Field No Pick-up Time (mins.)
50004	Monarch	103855	85	7.0	27.25	35.47	62.72	5.0
50006	Niagara	103857	85	7.0	27.24	35.67	62.91	4.0
50008	Niagara	103877	82	6.5	26.60	34.39	60.99	3.0
50010	Mobil	656W1	87	7.5	27.21	35.55	62.76	4.0
50011	Mobil	656W2	87	7.5	27.40	35.69	63.09	3.0
50014	Ibis	40-3234	70	6.0	26.40	34.23	60.63	2.5
50016	Ibis	40-3460	25	3.5	25.55	29.91	55.46	2.0
50018	Korzite	0-5566	37	5.0	25.46	32.43	57.89	2.0
50020	Sherwin Williams	C97WG143	87	7.5	27.34	35.92	63.26	11.0
Reference Paints	Ibis	Niteline II	82	6.5	26.72	35.26	61.98	2.0
	Niagara	95474	12	3.0	24.11	25.01	49.12	1.0
(Perfect Performance)					(36.50)	(36.50)	(73.00)	

Table 6

Summary of Laboratory and Field Test Results

Lab. Sample Number	Mfr.	Mfr. Code No.		% Best	Order at merit	Remarks - Failures
83-50004	Monarch	103855	(w)	99.14	5	Recommended for trial application
-50005	Monarch	103856	(y)			Recommended for trial application
-50006	Niagara	103857	(w)	99.44	3	Recommended for trial application
-50007	Niagara	103858	(y)			Recommended for trial application
-50008	Niagara	103877	(w)	96.41	7	Not recommended - settling
-50009	Niagara	103876	(y)			Not recommended - settling
-50010	Mobil	656W1	(w)	99.21	4	Not recommended - settling, bleeding, reflectance
-50012	Mobil	656Y2	(y)			Not recommended - settling, bleeding, pigment content
-50011	Mobil	656W2	(w)	99.73	2	Not recommended - settling, bleeding, reflectance, pigment content
-50013	Mobil	656Y1	(y)			Not recommended - settling, bleeding, pigment content, prime pigment
-50014	Ibis	40-3234	(w)	95.84	8	Recommended for trial application
-50015	Ibis	40-3235	(y)			Recommended for trial application
-50016	Ibis	40-3460	(w)	87.67	10	Not recommended - durability, viscosity, volatile, prime pigment
-50017	Ibis	40-3461	(y)			Not recommended - cold temp. viscosity, prime pigment
-50018	Korzite	0-5566	(w)	91.51	9	Not recommended - durability, settling, bleeding, viscosity, volatile content
-50019	Korzite	0-5572	(y)			Not recommended - settling, bleeding, viscosity, volatile content
-50020	Sherwin Williams	C97WG143	(w)	100.00	1	Not recommended - viscosity
-50021	Sherwin Williams	C97YG65	(y)			Not recommended - viscosity
References	Ibis	Niteline II	(w)	97.97	6	1982 shipment sample from Port Hope
	Niagara	95474	(w)	77.64	11	Does not meet MTC Form 1710, Feb. 1983 in composition (1982 batch samples)

% Best is based on service factors

Ministry of Transportation and Communications
Ontario

(METRIC)
1710–1

MTC FORM 1710
FEBRUARY, 1983

MATERIAL SPECIFICATION FOR CONING AND NON-CONING TRAFFIC PAINT

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1710.01 SCOPE

This specification covers the requirements for coning and non-coning type traffic paints which are capable of retention of overlay type reflectorizing glass beads, and are satisfactory for application to concrete and bituminous pavements.

When the Ministry purchases traffic paint with the colour, type of paint, delivery schedule and location, the number of 20 L containers desired and whether test samples are to be provided and the delivery schedule for test samples specified on a purchase order, the Ministry Purchase of Materials by Purchase Order section shall apply.

1710.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Ministry Material Specifications

Form 1750 Traffic Paint Reflectorizing Glass Beads

Canadian General Standards Board Specifications

CGSB 1-GP-12C-1965 Standard Paint Colours
CGSB 1-GP-71-1974 Method of Testing Paints and Pigments

Method 2.1 – Density Test
Method 4.5 – Stormer Consistency Test
Method 10.1 – Test for Skinning
Method 17.1 – Volatile Matter, Paints, Enamels, and Lacquers
Method 21.1 – Pigment Content, Ordinary Centrifuge Method
Method 24.1 – Water Content Test by Distillation Method

American National Standards Institute (ANSI)
American Society for Testing Materials Specifications (ASTM)

ANSI/ASTM-D126 -1965 – Methods for Chemical Analysis of Yellow, Orange and Green Pigments Containing Lead Chromate and Chromium Oxide Green

ANSI/ASTM-D185 -1972 – Methods of Test for Coarse Particles in Pigments, Pastes, and Paints

ASTM/D711 - 1975 – No-pick-up Time of Traffic Paint

ANSI/ASTM-D713 -1969 – Method of Conducting Road Service Tests on Traffic Paint

ASTM-D-868-1948 – Evaluating Degree of Bleeding of Traffic Paint

ASTM-D869-1978 – Evaluating Degree of Settling of Traffic Paint

ASTM-D969-1954 – Laboratory Test for Degree of Bleeding of Traffic Paint

ANSI/ASTM-D1210 -1079 – Test for Fineness of Dispersion of Pigmented-Vehicle Systems

ANSI/ASTM-D1306 -1980 – Test for Phthalic Anhydride Content of Alkyd and Resins and Esters Containing other Dibasic Acids

ANSI/ASTM-D1394 -1976 – Chemical Analysis of White Titanium Pigments

ANSI/ASTM-E97 -1979 – Test for 45-deg., 0-deg., Directional Reflectance of Opaque Specimens by Filter Photometry

ANSI/ASTM-D2697 -1973 – Test for Volume Nonvolatile Matter in Clear or Pigmented Coatings

1710.03 DEFINITIONS

Traffic Paint: means the paint used to delineate vehicle operating limits on pavement.

Non-Coning Paint: means traffic paint which when heated to 70-80°C at the spray nozzle, will be suitable for spray application and dries quickly.

Coning Paint: means traffic paint which is regular drying paint, and does not require heating prior to application.

Batch: means the paint produced from each mixing of properly proportioned paint ingredients.

1710.05 MATERIALS

1710.05.01 General

The materials used in the manufacture of the paint shall be such that the paint will not darken in service to impair the colour or visibility of the paint.

The traffic paint is intended for use with overlay beads which are applied after application of the paint. The paint shall provide proper anchorage for overlay glass beads.

NOTE: Samples of glass beads conforming to the requirements of Form 1750 and used by the Ministry for reflectorizing traffic paints may be obtained from the Ministry's Chemical Section free of charge for the purpose of determining the properties of the glass bead-paint mixture.

Paint shall be homogeneous, and shall be well ground to a uniform and smooth consistency. It shall be free from skin, dirt and other foreign particles, and shall be capable of being sprayed at the temperature intended for the type of paint (coning or non-coning) specified.

The paint shall flow evenly and smoothly and cover solidly in one coat when applied to pavements. The paint film shall be flat in finish, and shall provide a maximum amount of visibility under daylight and artificial light after the addition of the overlay glass beads.

1710.05.02 Colour and Cleaner

Paint shall conform to the following colour requirements:

(1) White paint - CGSB 1-GP-12C white 513-301

(2) Yellow paint - CGSB 1-GP-12C white 513-301 with yellow colouring to match the Ministry's yellow traffic paint. (Colour chip available from the Ministry's Purchasing Office.)

Cleaner solvent shall be that specified by the paint manufacturer.

1710.05.03 Physical and Chemical Requirements

Paint shall conform to the requirements of Table I.

TABLE I

TEST	REQUIREMENTS		TEST METHODS	
	Min.	Max.	C.G.S.B. 1-GP-71	A.S.T.M.
Water (% by mass)	–	0.5	24.1	–
Consistency (Krebs Units)				
at 25°C	80.0	90.0	4.5	–
at 7°C	–	120.0	4.5	–
Skinning	nil	nil	10.1	–
Settling (12 months)	8.0	–	–	D869
Hiding Power (m^2/L)*	8.37	–	–	–
Bleeding (coal tar saturated felt)	5.0	–	–	D969 and D868
Coarse Particles (% retained)				
on #60 sieve	nil	nil	–	D185
on #100 sieve	–	0.01		D185
Directional Reflectance (%)				
White	84.0	-	–	E97
Yellow	60.0	–	–	E97
Fineness of grind (Hegman)	3.0	–	–	D1210
Pigment Content (% by mass)	–	54.0	21.1	–
Prime Pigment (kg/L)	0.15	–	–	D1394
(TiO_2 or $PbCrO_4$)				D126
Non-Volatile Vehicle (% by mass)**	18.0	–	–	
Volatile Matter (% by Volume)	–	46.0	–	D2697
Trichloroethylene Solvent	nil	nil	73.1	–
CONING PAINT				
No pick-up Time (mins.)	–	15.0	–	D711
NON-CONING PAINT				
No Tracking Time *** (mins.)	–	1.0	–	–
Phthalic Anhydride (% by mass) Content of resin	40.0	–	–	D1306

* Based on Pfund black and white Cryptometer with #3.5 wedge.

** Determined by subtracting the volatile and pigment content percentages from 100 percent.

*** **No-tracking time**:
The no-tracking time of the non-coning traffic paint shall be determined by passing over the applied beaded line in a simulated passing manoeuvre with a passenger car. A line showing no visible deposition of paint to the pavement surface when viewed from a distance of about 15 metres shall be considered as showing "no-tracking" and conforming to the field drying requirement.

1710.09 MINISTRY PURCHASE OF MATERIAL BY PURCHASE ORDER

1710.09.01 Sampling and Testing

1710.09.01.01 Test Samples

Test samples of the paint which the supplier proposes to supply shall be delivered prepaid to the Ministry not later than the time and date set forth in the request for test samples, unless an extension of time has been granted by the Chemicals Section of the Ministry.

A test sample shall consist of 8 four-litre cans of each colour paint.

Not more than two test samples from a supplier will be accepted.

All test samples shall be clearly identified by the manufacturer's name and code number. Labels on the samples shall not be glued, but shall be fastened to the cans by means of adhesive tape or other means which will allow the label to be easily removed after arrival at the laboratory.

The supplier shall submit with each test sample, one completed "Paint Data Form" (see Appendix 1). The information given by the supplier on this form will be considered confidential. Test samples for which a "Paint Data Form" has not been submitted will not be considered.

Test samples shall be delivered prepaid to the following address:

Head, Chemicals Section
Central Building, Room 105
Ministry of Transportation and Communications
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

The samples shall be tested to determine whether they meet the requirements set out in this specification and may be subjected to trial batch and storage testing as outlined below.

1710.09.01.02 Trial Batch Application

At the discretion of the Ministry, a trial production batch of paint meeting the qualifications of 1710.05.03, Table 1, may be purchased for evaluation of application properties with Ministry painting equipment. The trial batch shall consist of a minimum quantity of one 200 L drum of paint.

Paint meeting the material requirements specified in this specification and with satisfactory loading and application properties when used with Ministry traffic paint application equipment will be considered for purchase.

The above loading and application properties cover characteristics such as:

- presence of lumps of paint and/or foreign matter;
- ease of pumping during loading and spraying, i.e.: 95% of the contents of a drum shall be pumped out, using a 25.4 mm sandpiper pump (model SD-1A) with a head of 2 m, within 5 minutes. Pumping shall be at a paint temperature of 7°C and shall be pumped from a bung hole located on the top of an upright drum;
- satisfactory no tracking time;
- paint overspray on pavement and equipment, i.e.: using a 449 tip, not less than 80% of the paint leaving the spray tip shall be deposited and remain as a stripe 10 cm in width and 230 μm in dry film thickness on a target located 11.5 cm from the spray tip.

1710.09.02 Certificate of Compliance

The manufacturer shall submit a certificate of compliance with tenders indicating that the physical properties and chemical composition of all of the manufacturer's production batches of traffic paint shall not deviate from those of the test sample unless approved by the Purchaser.

1710.09.03 Delivery and Packaging of Paint and Solvent

The delivery schedule, delivery location, colour, and quantity shall be as specified on the Ministry's Purchase Order.

The paint and solvent shall be furnished in clean new unlined non-returnable 204.5 L drums. Drums shall be 1.2 mm steel having a closed head and equipped with a 50 mm bung and an 18 mm bung.

Each drum shall be clearly marked with weather resistant markings to show the following information:

a) Colour and Type of Paint (coning or non-coning)
b) Traffic Paint
c) Manufacturer's name and address
d) Manufacturer's code and batch numbers
e) Date of filling the drum
f) Volume of contents in litres

Drums shall be well made, in good condition and absolutely free from all signs of leakage, before and at the time of shipment.

A small portion of the traffic paint may be required in twenty-litre containers. The number will be specified on the Purchase Order.

1710.09.04 Quality Assurance

1710.09.04.01 General

Samples may be taken from shipments at any time; production batch samples will be taken from each batch. These samples shall be subject to inspection, and testing. The physical and chemical properties of all shipment and manufacturer's production batch samples shall be the same as those of the test sample (except as otherwise noted in clause 1710.09.04.02). Failure to meet the requirements of this specification shall be cause for rejection of the corresponding batches of paint.

1710.09.04.02 Production Batches

Each supplier awarded a contract for the supply of traffic paint shall supply the Chemicals Section with a one-litre sample from each production batch. These production batch samples shall be delivered in the same manner as specified in clause 1710.09.01.01, within two days of manufacture of the respective batches.

Delivery records shall be kept, by the supplier, of the number of containers of each batch shipped to each delivery point and a list of such shipments during each calendar week shall be given to the Ministry at the end of each week until the entire order is completed and shipped.

In addition to the physical and chemical requirements, production batch samples shall meet the following requirements:

Mass/litre – The mass/litre of each production batch sample shall be within 0.05 kg/L of the value established on the test sample.

C.G.S.B. Method 2.1 of 1-GP-71

Composition – The pigment, vehicle solids and volatile contents of each production batch sample shall be within 2% of the values established on the test sample.

C.G.S.B. Method 17.1 and 21.1 of 1-GP-71

No pick-up time – The laboratory no pick-up time of each production batch sample shall be within two minutes of the value established for the test samples.

1710.09.04.03 Storage

The paint shall not skin, gel, settle or cake in the drums when stored outside under summer and winter conditions for a period of one year from the time of delivery.

1710.09.05 Measurement for Payment

Traffic paint will be measured in litres.

1710.09.06 Basis of Payment

Payment at the contract price for coning or non-coning traffic paint shall be full compensation for all labour, equipment and materials including test and production samples and for supplying and delivering the paint as specified herein and by the Ministry's Purchase Order.

1710.10 DESIGNATED SOURCE REQUIREMENTS

1710.10.01 General

In order for a Supplier to be considered for addition to the list of accepted suppliers (list of Designated Sources for Materials) for traffic paint, the Supplier shall submit test samples as outlined in clause 1710.09.01.01 for conformance to specified requirements, service testing of test samples and production evaluation.

If the test samples meet all the material requirements, the service test results are satisfactory, and the Ministry is satisfied with production procedures and the ability of the Supplier to meet all requirements specified in this specification, then the Ministry will, upon written request from the Supplier to the address below, place the Supplier on the list of Designated Sources for Materials.

Suppliers desiring inclusion on the Lists of Designated Sources shall make application in writing to:

Ministry of Transportation and Communications,
Ontario
Purchasing Supervisor
Materials & Operating Supplies Section
Purchasing and Supply Office
Supply Branch, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

1710.10.02 Service Test

Paints will be service tested in accordance with ASTM D713, as amended by the following:

A service test consisting of the application of the paint on bituminous or concrete pavement with 20 000 AADT using Ministry equipment and the subsequent addition of overlay glass beads meeting the requirements of Form 1750, in the proportion of 0.7 kg of beads to one litre of paint, shall be carried out.

The ease and uniformity of application, severity of overspray (if any), covering properties and drying time will be evaluated during application.

The applied paint will be inspected periodically, during a twelve month period, for the following:

(i) Appearance
(ii) Colour
(iii) Luminous Directional Reflectance
(iv) Abrasion Resistance (Durability)

General appearance and colour of the paint shall have satisfactory ratings (7 or higher, according to ANSI/ASTM D713) after one year of service.

The overall suitability of the paint will be based on the results obtained in the service test and compliance with all other requirements listed in this specification.

(METRIC)
1710–5

APPENDIX 1

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

PAINT DATA FORM

Manufacturer _____

Manufacturer's Code No. _____

Type of Paint (coning, non-coning) _____

Colour of Paint _____

Composition of Paint	% by Mass	% by Volume
Pigment	_____	_____
Non-Volatile	_____	_____
Volatile	_____	_____

Composition of Pigment	% by Mass
(1)	
(2)	
(3)	
(4)	
(5)	
(6)	
(7)	
(8)	

Type of Vehicle _____

Type of Thinner _____

Type of Driers _____

NOTE: Above form to be completed and forwarded with paint sample. Samples submitted without a completed Paint Data Form will not be considered.

Chemicals Section Comments:

MTC FORM 1750
FEBRUARY, 1982

MATERIAL SPECIFICATION FOR TRAFFIC PAINT REFLECTORIZING GLASS BEADS

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1750.01 SCOPE

This specification covers the requirements for glass beads for use with traffic paint and requirements for Ministry purchase of reflectorizing glass beads.

1750.02 REFERENCES

This specification refers to the following standards, specifications or publications:

American Society for Testing Materials Specifications

ASTM D1155 – 1953 – Standard Test Method for Roundness of Glass Spheres

ASTM D1214 – 1958 – Standard Method of Sieve Analysis of Glass Spheres

ANSI/ASTM E11 – 1981 – Wire Cloth Sieves for Testing purposes

1750.05 MATERIALS

1750.05.01 Durability

The beads shall be manufactured from glass of a composition designed to be highly resistant to the effects of traffic wear and weathering.

1750.05.02 Colour

The glass shall be colourless to a degree that the resulting beads, when added to white paint, do not impart a noticeable hue.

1750.05.03 Bead Type and Grade

Beads shall be supplied in the OVERLAY type and MOISTURE PROOF grade. The beads shall be treated in such a manner as to overcome the effects of water, as vapour or liquid, on the beads before the beads are added to the paint stripe.

1750.07 PRODUCTION

1750.07.01 Roundness

At least 70% by mass of the glass beads shall be true spheres.

1750.07.02 Gradation

The glass beads shall meet the following gradation requirements when tested according to ASTM D1214.

US Standard ASTM E11 Sieve Series	Opening µm	Percentage Passing by Dry Mass
		Overlay Type
No. 20	850	100
No. 30	600	95 - 100
No. 40	425	45 - 70
No. 50	300	20 - 40
No. 70	212	5 - 20
No. 100	150	0 - 3

1750.07.03 Refractive Index

The index of refraction of the glass beads, when tested by the immersion method at 25 C under tungsten light, shall not be less than 1.50.

1750.07.04 Imperfections

The surface of the beads shall be smooth, lustrous and free from film, scratches and pits.

Not more than 25% by mass of the true spheres shall have imperfections such as milkiness, dark specks, incipient fractures, and air inclusions in the form of bubbles greater than 10% of the volume of the spheres.

1750.09 MINISTRY PURCHASE BY PURCHASE ORDER

1750.09.01 Sampling and Testing

1750.09.01.01 General

A maximum of 10% but no less than 1% of the total number of packages in each batch will be taken at random for test purposes by the Ministry. The contents of each random package will be riffled until a representative sample of approximately 1000 g (or 500 ml) of beads is obtained. The 1000 g samples will be combined to form a composite sample of about 4 kg (about 4 L in volume) representing a batch of 25 000 kg of beads. The composite sample will be riffled in the laboratory until about a 150 g sample is obtained for the following testing.

1750.09 01.02 Roundness Testing

The percentage true spheres shall be determined by one of the following methods:

(a) by counting the beads under 50X and 100X magnification as follows:

- Glass beads larger than #50 sieve size inclusive, shall be counted under 50X magnification (see gradation requirements).
- Glass beads smaller than #50 sieve size shall be counted under 100X magnification.
- Approximately 1,000 beads contained loosely in a culture dish shall be counted under reflected light for each sieve specified to determine the percentage by mass of perfectly round spheres.

(b) by ASTM D1155.

1750.09.01.03 Imperfections Testing

Imperfections shall be evaluated by observation under 50X and 100X magnification.

1750.09.01.04 Water Resistance Test

One hundred grams of glass beads will be placed in a 500 ml beaker and an equivalent volume of distilled water will be flowed into the beaker on top of the glass beads. The beaker will be permitted to stand for 5 min. At the end of this period, the water shall be poured off and the glass beads will be transferred to a clean, dry beaker and permitted to stand for 5 min. The spheres will then be introduced into a standard 125 mm diameter glass funnel having a stem of 125 mm length. The beads shall flow through the funnel without stoppage. (Slight initial agitation to start the flow through the funnel at the beginning of the test will be permissible.)

1750.09.02 Packaging

Beads in bags shall be free of clusters, lumps, moisture and foreign matter.

Glass beads shall be packaged in bags of 25 kg net capacity, and each bag shall be marked to show clearly the following information:

1) "Overlay Type Glass Beads"
2) "Moisture Proof Grade"
3) "MTC"
4) "Batch number"
5) "Manufacturer's name"

} (marked in 25 mm high letters)

Bags shall be paperlined burlap with 50 μm polyethylene inserts. The burlap liner, all seams and top closures shall be waterproof and leakproof and shall be capable of maintaining these properties during transportation and numerous handlings.

Bags shall be approximately 0.35 m x 0.86 m with the 50 μm polyethylene insert being 0.35 m x 0.96 m.

All bags shall be subject to prior approval by the Ministry and shall be or be equal in quality to either:

1) A Bemis Waterproof, Standard Type, single paper lined, cemented centre seam, taped bottom bag, produced by Bemis Bros. Bag Company, St. Louis, Missouri, U.S.A., or

2) A Lloyd jute bag with polyethylene liner, Code #1010, produced by Lloyd Bag Company Limited, 114 St. Clair Street, Chatham, Ontario.

1750.09.03 Delivery

Delivery details and scheduling shall be as stipulated on the Ministry's Purchase Order.

1750.09.04 Quality Assurance

Any shipment or shipments of this material supplied to the Ministry will be sampled and tested within a 30 day period immediately following the date of the delivery. Failure to meet the requirements of this specification shall constitute cause for rejection of the shipment. Upon rejection of the shipment, the letters "MTC" shall be made permanently illegible on each bag of the shipment. Rejected materials shall be expeditiously removed and replaced with acceptable materials at no additional cost to the Ministry.

1750.09.05 Measurement for Payment

Measurement for payment will be in kilograms of beads delivered.

1750.09.06 Basis of Payment

Payment at the contract price per kilogram shall be full compensation for all labour, equipment and material to supply and deliver the beads as specified on the Ministry's Purchase Order.

APPENDIX 3

Non-Coning Traffic Paint Test Samples

Supplier	White Paint	Yellow Paint
Monarch Paint Co.	103855	103856
Niagara Paint & Chemical Co. Ltd.	103857	103858
Niagara Paint & Chemical Co. Ltd.	103877	103876
Mobil Chemical Canada, Ltd.	656-W1	656-Y2
Mobil Chemical Canada, Ltd.	656-W2	656-Y1
Ibis Products Ltd.	40-3234	40-3235
Ibis Products Ltd.	40-3460	40-3461
Cuprinol Korzite Ltd.	0-5566	0-5572
Sherwin-Williams Canada Inc.	C97WG143	C97YG65

APPENDIX 4

Mr. J. F. Lougheed,
Special Maintenance Services Engineer,
Maintenance Operations Office,
Central Building, Room 235

84 08 16

File Number: 3162-2-2-301

From: Engineering Materials Office,
Chemicals Section,
Central Building, Room 105

Traffic Paint Evaluation Samples

The 1983-84 laboratory evaluation of non-coning traffic paint based on the MTC Form 1710, February 1983 Material Specification for Coning and Non-Coning Traffic Paint has been completed by the Chemicals Section. A total of nine test samples each of white and yellow traffic paint were submitted by six suppliers.

Based on the performance rating for durability, reflectance, and general appearance of the test stripes as determined in our service test, the following paints are considered to meet specification requirements with the exception of application properties of the paints in the standard striping machine.

Supplier	White Paint	Yellow Paint
Monarch Paint Co.	103855	103856
Niagara Paint & Chemical Co.	103857	103858
Ibis Products Ltd.	40-3234	40-3235

Note: Monarch Paint Co. and Ibis Products Ltd. paints contain chlorinated solvent but the Niagara Paint & Chemical Co. product does not.

As you suggested, a trial batch of about two drums (approximately 400 L) of each of the above three yellow paints should be purchased and applied in your selected district (Huntsville) to determine loading and application characteristics of the paints, such as ease of pumping during loading and spraying, no-tracking time, paint overspray and dribbling, etc.

Please notify us when arrangements for the trial application have been completed so that we may also observe the test application.

R. Fujii,
Chemical Engineer,
Chemicals Section.

RF:ma

memorandum

Ontario

APPENDIX 5

To: Mr. D.A.O. White,
District Engineer,
HUNTSVILLE.

Date: 84 08 17

Attention: Don Boucher

Re: Traffic Paint Test 1983-84

Attached is a memo from R. Fugii that indicates there are three paints considered to meet our specifications.

In order to assess loading and application characteristics, it is desirable to use the normal method of application.

This is to confirm our telephone conversation of 84 08 17 that you would be willing to do this on Hwy. 60 if the material can be supplied.

I have indicated to E. Sacks, Niagara Paints and K. Whitely that we would be doing the test in Huntsville District.

Both companies indicated that material would be available at approximately the same price as this year's supply.

Ibis price is $1.44 per litre - Niagara price is $1.91 per litre. This is Niagara's chlorinated solvent type paint price.

Please submit a D4 to R. Langlands for material and labour.

I would hope it would take no more than two days to do the six drums.

I would suggest using Ibis the first day. This would allow travel and preparation time in the morning. Application and discussion on performance in the p.m.

The second day use Niagara and Monarch as they are one and the same supplier. This would allow both manufacturers to have their representative on the site, if they so wish.

Thank you for your cooperation.

J.F. Lougheed,
Supervisor,
Special Maintenance Services,
Maintenance Branch.

CHEMICALS SECTION
RECD.
AUG 22 1984
ENGINEERING MATERIALS OFFICE

c.c. R. Sterk

Attach.

APPENDIX 6

MEMORANDUM:

Date: 84 09 27

To: Mr. G.R. Ricker,
Regional Municipal
Maintenance Engineer,
Northern Region,
North Bay, Ontario.

Mr. D.A.O. White
District Engineer,
District #11,
Huntsville, Ontario.

CHEMICALS SECTION
REC'D.
SEP 28 1984
ENGINEERING MATERIALS OFFICE

From: Maintenance Branch,
Room 234, Central Bldg.,
1201 Wilson Avenue,
Downsview, Ontario.

Re: Field Evaluation of New Non Coning Traffic Paint

On 84 09 11 Mr. J. Lougheed, Supervisor, Special Maintenance Services Unit and I travelled to Huntsville District to meet with Mr. G. Bowen, Mr. A. Kagetsu of the Engineering Materials Office and Mr. R. Martin, Mr. V. Lui of the Equipment Engineering Materials Office. It was pre-arranged with Huntsville District in co-operation with Mr. K. Whitely representing Ibis Paint and Mr. E. Sacks representing Niagara Paint to apply six drums of test paint over a two day period. The Ibis paint was applied during the late morning early afternoon of 84 09 11 and the four drums of Niagara were applied during the morning of 84 09 12. The actual test took place beginning at the Dwight patrol yard eastward into Algonquin Park, Highway 60. The climatic conditions were good, temperatures low 60's, light winds and it had rained prior to the test cleaning the pavement. The paint was applied to a dry surface.

The Engineering Materials Office had developed a new non-coningtraffic paint specification which was similar in nature to Niteline II paint. Samples of the new paints were submitted by suppliers and applied as transverse test lines by the lab, testing their durability performance. From the ensuing monitoring, the durability performance was encouraging for three of the paints tested. As a result it was decided to have the test paints applied by District 11, Huntsville to test their compatibility with M.T.C. equipment and monitor their application characteristics. The Huntsville striper was equipped with tandem paint guns using Graco #457 fluid tips in the lead paint guns followed

by 465 fluid tips in the trailing guns. The striper had the capabilities of heating the paint to approximately 150°F at the paint guns. The machine operated at approximately 16 km/h at 1200 p.s.i. at the pump obtaining an approximate 8 mill dry film thickness.

The following observations were noted during the various test applications.

IBIS PAINT

Loading times were similar to other paints at this time of the year 4-5 minutes per drum. There was some overspray, light wet splatter. At the completion of the test there was paint hanging from the buggy as a result of wet type overspray. The no track drying time was approximately six minutes and a hard dry time of approximately 12 minutes. Once the paint reached full temperature in the machine the paint guns did not shut off properly and there was a dribble affect. This phenomenon was apparent when painting broken lines and combination of lines.

NIAGARA PAINT

Loading times were slightly longer approximately 6 minutes per drum. There was some overspray during application and the machine also had a wet paint splash appearance on the buggy similar to the Ibis test paint. This paint took slightly longer to dry, 8 minutes plus, and a 18 to 20 minutes before it was hard dry.

NIAGARA PAINT (MONARCH)

Loading times were similar to the other paints, 5-6 minutes per drum, overspray characteristics as above. It also had similar no pick up dry times but this paint stayed tacky.

It is planned to continue the monitoring of these lines for a year.

To conclude it is the opinion of the representatives of the Maintenance Office that the paints tested in Huntsville District this year were unacceptable for use by M.T.C. because of the extended dry times. The overspray that was observed was not desirable but could be considered as an acceptable level. There has been discussions with the representative from Niagara Paint who indicated that the

../2

paint tested would dry much faster if it was applied at 150°F. This is something which must be looked into including discussions whether there is any need to alter the current specification and what further testing will be required.

J.F. Lougheed,
Supervisor,
Special Maintenance
Services Unit.

N.G. Murton,
Sign & Zone Painting
Technician,
Special Maintenance
Services Unit.

NGM/JFL/nn

c.c. K. Kirchner
R. Sterk
R. Gaunt

DISTRIBUTION LIST

D. R. Brohm
O. P. Churchill
K. G. Forker
J. F. Lougheed

Regional Maintenance/Municipal Engineers

G. M. Sinclair
E. J. Zavitski
G. Ricker
J. K. Robinson
J. H. Blevins

District Engineers

District	# 1,	R. L. Hanton
	# 2,	R. E. Thompson
	# 3,	J. T. Kernaghan
	# 4,	A. J. Percy
	# 5,	D. A. Leckie
	# 6,	R. W. Oddson
	# 7,	W. J. Peck
	# 8,	R. C. Wycliffe
	# 9,	M. J. MacMaster
	#10,	D. A. MacDonald
	#11,	D. A. O. White
	#13,	B. D. MacKinnon
	#14,	J. J. McNamee
	#16,	D. E. Moorhouse
	#17,	H. K. Kirchner
	#18,	W. A. Stewart
	#19,	F. M. Adams
	#20,	C. C. Yuill